NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

AN ANALYSIS OF U.S. AIR FORCE PILOT SEPARATION DECISIONS

by

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March 2010

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** March 2010	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE An Analysis of U.S. Air Force Pilot Separation Decisions		**5. FUNDING NUMBERS**	
6. AUTHORS Zeki Gultekin, Omer Canpolat			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000		**8. PERFORMING ORGANIZATION REPORT NUMBER**	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol Number _____.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release, distribution is unlimited.		**12b. DISTRIBUTION CODE**	

13. ABSTRACT (maximum 200 words)

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14. SUBJECT TERMS Attrition, U.S. Air Force Pilots, Commissioning Source, Logit Model, Retention	**15. NUMBER OF PAGES** 73
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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MASTER OF SCIENCE IN MANAGEMENT

from the

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This thesis analyzes the factors that are associated with separation behavior among United States Air Force pilots. Additionally, the effect of commissioning source on separation was analyzed. Logistic regression models were estimated for U.S. Air Force pilots commissioned between 1994 and 2006. Data records utilized in this thesis were obtained from Defense Manpower Data Center (DMDC). Demographics and professional/educational factors were included in the models to analyze their effects on the separation decision. By identifying the determinants of separation, the thesis attempts to suggest ways in which decision makers might reduce losses among Air Force pilots.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACP	Aviator Continuation Pay
ACIP	Aviation Career Incentive Pay
AFIT	Air Force Institute of Technology
AFQT	Armed Forces Qualification Test
AFROTC	Air Force Reserve Officer Training Corps
AFSC	Air Force Specialty Code
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DRM	Dynamic Retention Model
FAIP	First Assignment Instructor Pilot
GAO	General Accounting Office
LPM	Linear Probability Model
MLE	Maximum Likelihood Estimation
MSR	Minimum Service Requirement
NPS	Naval Postgraduate School
NSAv	Non-standard Aviation Aircraft
OLS	Ordinary Least Squares
OTS	Officer Training School
SSB	Special Separation Benefit Program
UAV	Unmanned Aerial Vehicle
USAF	United States Air Force

USAFA	United States Air Force Academy
UPT	Undergraduate Pilot Training Program
VSI	Voluntary Separation Incentives

ACKNOWLEDGMENTS

We express our sincere appreciation to our thesis advisors Professor Stephen Mehay and Bryan Hudgens for their patience, valuable guidance, and help on data collection. We could not have written this thesis without their priceless contributions. We felt obliged to thank to all our instructors who made the time we spent in the Naval Postgraduate School a worthwhile experience.

We owe a great deal of thanks to Turkish Air Force for providing us the opportunity to study at NPS, and our families for their continuous support and encouragement.

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I. INTRODUCTION

Military pilots are obviously crucial to any mission employing combat air forces. The role of pilots will increase in importance as the number of global peacekeeping missions increase. A poor retention rate for senior pilots, however, is one of the biggest concerns of the Air Force. The Air Force invests a considerable amount of money both in human capital and in the training of a pilot. As a result of the growing number of peacekeeping missions and the low retention of pilots, the United States Air Force (USAF) has increased the use of Unmanned Aerial Vehicles (UAVs). This situation has triggered increased demand for pilots in the Air Force (Taylor, Moore, and Roll, 2000).

It is always difficult for the Air Force to keep experienced pilots in the service. Experienced pilots frequently separate to fly in the civilian airline sector. Retention or turnover of experienced personnel is a problem of major importance in the military and has been for at least 40 years. According to Lt. Col. Harris Boyce:

> The effectiveness of the Air Force, as an instrument for ensuring peace, depends on its ability to kill and destroy more efficiently than any potential enemy. In order for the United States Air Force to maintain aerial supremacy, it must recruit and retain the most highly qualified professional officer corp. In looking to the future, one cannot be completely confident of very many things; however we can be reasonably certain that during the next twenty years the world will continue to be full of conflicting interests and national objectives will have to be supported by military power. As long as military power is needed, the Air Force tactical fighter pilot will be needed. Weakness has proven to be an invitation to aggression many times in past history and a strong tactical air-strike capability may provide a deterrent to future limited wars. (1967)

High attrition rates waste training investments and reduce effectiveness. So that policy decisions may be based on variables that significantly affect retention, it is critical for policy makers to know the reasons for high attrition rates. According to a recent RAND study, “earnings opportunities in the civilian market relative to military pay, operational tempo, frequency of deployment, adequacy of flying hours available to pilots, type of flying available, dissatisfaction with the disparity in bonus pay among military

pilots, the length of time it takes to become fully trained and attitudes toward leadership in higher echelons" are some of the important factors potentially affecting pilot attrition (Elliot, Kapur, and Gresenz, 2004).

This thesis analyzes the factors that cause attrition among United States Air Force pilots. Additionally, it analyzes whether commissioning source affects the attrition decision of USAF pilots. The study identifies determinants of attrition and, therefore, suggests ways in which decision makers might reduce attrition among Air Force pilots. The study uses logistic regression models to measure characteristics of factors that cause attrition. This research uses longitudinal data to analyze stay or leave decisions made over time.

II. BACKGROUND, LITERATURE REVIEW, AND RESEARCH QUESTIONS

A. BACKGROUND

There are three major commissioning sources for new Air Force pilots: U.S. Air Force Academy, Air Force Reserve Officer Training Corps (AFROTC), and Officer Training School (OTS). In Fiscal Year 2007, the Air Force Academy produced 974 officers; AFROTC produced 1,927 officers; and OTS produced 559 officers (Office of the Under Secretary of Defense, 2009). According to Air Force active duty demographics information, which is current as of October 5, 2009, 19.15 percent of the officers were commissioned through the Air Force Academy; 42.8 percent through AFROTC and 19 percent through OTS. The remaining 17.2 percent were commissioned through other programs (e.g., direct appointment) (U.S. Air Force Official Web site, 2009).

The first commissioning source is the Air Force Academy, located in Colorado Springs, Colorado, which provides a 4-year undergraduate course of scholastic, military, and physical instruction at no tuition cost for students, who also receive a stipend. The largest source of commissioned officers is the Air Force Reserve Officer Training Corps (AFROTC), which is available at nearly 1000 colleges and universities across the country and offers scholarships to high school and college students with outstanding academic and leadership qualities. One- to four-year scholarships are offered to scholarship recipients, who receive partial or full tuition, as well as a nontaxable monthly stipend (U.S. Air Force Official Web site, 2009). The third commissioning source is Officer Training School (OTS), which requires at least 12 weeks of intensive training. Compared with the Academy and AFROTC, OTS students, in general, have earlier military training. This means that they were formerly enlisted in the military.

After primary officer training and commissioning, all pilot candidates go to the Undergraduate Pilot Training Program (UPT) for approximately 54 weeks. During UPT, candidates request track preference and they pick their track, not their aircraft. The track that students select determines what type of aircraft they are assigned after UPT. Students

can either choose Bomber, Tanker, Multiengine Turboprop, or Helicopter Training tracks. Graduates who choose bomber track can select F-22, F-16, F-15C, F-15E, A-10, B-1, B-52, B-2 aircraft, Unmanned Aerial Vehicles (UAV), or First Assignment Instructor Pilot (FAIP). They are eligible for any Tanker, Transport, or Special Operation aircraft. Graduates who choose tanker track can select C-5, C-17, C-130, KC-10, KC-135, RC-135, E-3, E-8, MC-12, U-28 aircraft, UAV, FAIP, and Non-standard Aviation aircraft (NSAv). Graduates who choose multiengine turboprop track can select C-130, MC-130, AC-130, EC-130, C-12, MC-12, U-28 aircraft, NSAv, and UAV. Graduates who choose helicopter-training track can select UH-1, HH-60 helicopters, CV-22 aircraft, and FAIP. At the end of UPT, they attend Advanced Training Phases for specific types of aircraft. After successfully completing this training, pilots begin their active duty in flight units.

B. LITERATURE REVIEW

Pilots usually have four- to five-year service obligations, and they are eligible to separate from service. After these initial obligations expire, the Air Force accepts that it has had difficulties retaining pilots with six to eleven years of service, who are usually attracted by the job offers of civilian airlines. In their report, Mattock and Arkes state the Air Force concerns with these words, "In the testimony before the House Armed Service Committee in July 2001, the Chief of Staff of the Air Force cited retention as the most pressing problem facing the Air Force. Retaining pilots, information technology specialists, scientists, and engineers was proving particularly difficult" (Mattock & Arkes, 2007). To induce pilots to remain in the service, the Air Force had previously developed a pay incentive program. This Aviator Continuation Pay (ACP) program pays an annual bonus to pilots who commit to certain terms of service (Aviator Continuation Pay Program, 2000). Thus, if pilots choose to stay in the Air Force under an ACP agreement, then they are giving up the opportunity to fly for civilian airlines for that time period (Mattock & Arkes, 2007).

Individuals' behavior is the key to their retention decisions. It is obvious that Air Force compensation policies affect a service member's decision to stay or leave. On the

other hand, the effects of those policies differ from person to person. For instance, one pilot who really enjoys military service may choose to stay in the service for less compensation than another one who doesn't enjoy military service as much. Besides individuals' characteristics and behaviors, external influences are important in retention decisions, too. For example, if the civilian job market for pilots is strong, then the motivation to leave would be relatively greater than if the market is poor or the pilots are not needed by civilian airlines (Mattock & Arkes, 2007).

There are many studies of retention of Air Force personnel. Each study analyzed different aspects of retention by using different techniques and models. Because the effects of the external (e.g., such as the overall economy) and internal (within the Air Force) factors affecting the decision to stay or leave are diversified, this thesis looked at studies that analyzed both external and internal factors.

The U.S. Air Force knows that it needs to retain the appropriate quantity and quality of officers to execute current and future missions. To attract, promote, and retain the experienced officers, USAF uses the pay and promotion systems as a key tool in officer retention efforts. Therefore, as Mattock and Arkes (2007) implied, the USAF wants to know the internal effects of changes in pay and promotion policies on officer retention.

To provide independent analysis of policy alternatives for USAF, RAND researchers Mattock and Arkes (2007) worked on the Dynamic Retention Model (DRM) developed by Gotz and Mccall (1984) and extended the basic DRM to take into account the effect of the availability of multiyear contracts on the retention of certain classes of Air Force officers. The researchers' objective was to model how people make retention decisions in an uncertain world to develop a set of retention policies that would retain the right number and quality of officers wanted. They developed a method for statistically estimating DRM parameters using historical officer data and simulating the effect of changes in personnel policies on retention. Mattock and Arkes (2007) state, "Unlike other models, the DRM takes into account the value an officer may place on future career

flexibility and thus is particularly well suited to examining the effect of bonus programs that have service commitments, such as the Aviator Continuation Pay (ACP) program."

The model described in their report was initially developed for a Fiscal Year 2003 project. The research was conducted in the Manpower, Personnel, and Training Programs of RAND Project Air Force. The report interested those involved in Air Force officer personnel management and those with an interest in modeling to support development of personnel policies. After researching the effects of personnel policies on retention by using DRM, Mattock and Arkes (2007) found that to model individual behavior uncertainty should be included in models. As Mattock and Arkes state,

> Modeling individual behavior requires modeling uncertainty explicitly. The individual components of uncertainty include elements that are known to the officer but unknown to the analyst, such as individual taste. The components of uncertainty also include elements that are unknown to both the officer and analyst, such as future environmental shocks and future promotions. By modeling how these elements affect an individual officer's decision-making process, it can be found a better understanding of how an officer might value future career flexibility in the face of uncertainty. (2007)

Mattock and Arkes (2007) concluded that the DRM, which covers ACP, fitted the data well, and can be used as an effective tool for analyzing how officers respond to multiyear agreements. They recommended that Air Force should adopt the DRM and consider widening its application (Mattock & Arkes, 2007).

Lu (1995) also analyzed internal factors that cause attrition among Air Force pilots. He followed Roth's (1981) study and used a similar research pattern. Lu (1995), however, did not address attrition rates for all Air Force personnel. Rather, he examined only Air Force pilots. He estimated empirical models for all pilots entering the officer corps between 1976 and 1986. He used Two-Stage Logit Analysis to estimate the effect of several factors, such as "age at commissioned service as an officer, education level, race, source of commission, marital status, dependents, years of commissioned service, type of commission, flying status and prior enlisted," including whether an individual is a member of a minority group, on pilots' decisions to remain in the Air Force (Lu, 1995). He attempted to explore the relationship between pilot recruits' background

characteristics and their ability to adapt to the service. He thought that there might be differences between minority (Afro-American) pilots and other (Caucasian) pilots in terms of retention.

Lu found that:

> Age at the time of commissioning has a significant effect on attrition decision. Older age at commission increases the likelihood that pilots will separate. Those who leave also have shorter terms of service than pilots who entered at a younger age. (1995)

In contrast to the Roth (1981) study, Lu (1995) compared minority groups and non-minority groups. Lu found that "…being a member of a minority group (other than white males) has a significant effect. A member of a minority is more likely to remain in the Air Force than a non-minority." (Lu, 1995) His study also showed that possessing Masters' Degrees or higher-level degrees, being commissioned from a military academy, and flying status have significant impacts on attrition.

The studies that dealt with external factors mostly looked at civilian airline hiring rates. Commercial airline hiring rates are viewed as the biggest threat to aviator retention. For example, Levy (1995) analyzed the interactions between civilian airlines and retention of military pilots and the final sustainability of the required military pilot force. As she mentioned in her report, "The military has historically been concerned that the civilian airlines have had detrimental effect on military retention and this has been often cited as the central problem in management of military pilots." (Levy, 1995)

On the other hand, this is not always the case. Levy also stated that when historical data is examined, it can be seen that there are time periods where there is an inverse relationship between civilian airline hiring and military pilot retention (that is, when civilian airline hiring goes up, military pilot retention goes down). At other times, military retention and civilian hiring move in the same direction. Obviously, these inverse and positive relationships between hiring and retention behaviors at different time periods show that other factors (e.g., military career opportunity, time separated from families, and overall morale) can and do have significant impact on the retention of military pilots (Levy, 1995).

To understand the effects of civilian airliners on military pilot retention, there are basically three questions, which should be answered. First, what number of pilots do the civilian airlines likely need, both in terms of overall requirements and requirement of new pilot hires? The result of the interaction of demand and supply creates how many pilots are actually hired. Demand for airline travel is closely related to the demand for pilots and airline travel depends on the general health of the U.S. economy. It is particularly difficult to forecast the shifts in the demand for airline travel and, as a result, shifts in the demand for airline pilots. This is because it is also difficult to forecast the course of the U.S. economy. Moreover, a number of other factors affect the demand for pilots, such as equipment purchases and equipment configuration changes, retirements and attrition from inventory, utilization rates of existing aircraft, route structure changes, and specific working conditions set out in labor contracts. According to Levy (1995), military planners' biggest concern is that civilian airline demand for military pilots will exceed the supply available and influence these highly trained and valuable pilots to separate from the military. On the other hand, if too many pilots remain in the military, the higher retention can cause difficulties in the accession of new pilots, the promotion of younger cohorts, and the assignment system in general (Levy, 1995).

The other question is: how many military pilots are available for civilian airline hiring? Thus, the interaction between airline hiring and military separation should be estimated. Levy (1995) assumed that if relative civilian-military wages remain constant, the number of military losses could provide an answer to this question.

The third and last question: will there be future problems regarding the flows of military pilots to civilian airlines and what should the policy makers do to manage the pilot flow? The previous two basic questions' answers will provide a primitive answer for this third question. Policy makers and military planners should start to find solutions of military retention problems by seeking answers to those basic questions.

In a RAND study of attrition, Elliot, Kapur, and Gresenz (2004) also explored some external determinants of attrition problem among male pilots in the Air Force, Navy, and Marine Corps. Specifically, they looked at the relationship between attrition

and military compensation changes. They merged three military databases to estimate stay or leave decision of pilots across the services.

Elliot, Kapur, and Gresenz's (2004) study examined the effect of voluntary separation programs, deployment, compensation, and civilian airline hiring on attrition. They believed that these variables are important to explain attrition among military pilots. In their study, they included military personnel files' data and civilian airline information data. They concentrated on voluntary separation at the end of initial service obligation by using simplified models.

Elliot, Kapur, and Gresenz (2004) included "military and civilian opportunities over time, measures of deployment and deployment specifically to hostile territories, an indicator variable for fighter and bomber pilots, marital status, source of commission (academy or non-academy), an indicator variable for the effect of the Gulf War stop-loss policy and eligibility for separation." They also included reserve versus regular commission, the number of pilots hired by the major airlines, and variables related to incentive programs, such as Voluntary Separation Incentives (VSI) and Special Separation Benefit Program (SSB). Their findings emphasized the relationship between attrition and deployment, compensation, and civilian airline hiring. "Increases in major airline hiring are very strongly associated with increases in military pilot attrition, especially for airplane pilots in the Air Force. This finding is particularly interesting in the face of projected long-term increases in major airline hiring." (Elliot, Kapur, and Gresenz, 2004) They emphasized the impact of civilian airline hiring on attrition among military pilots. They underlined the importance of civilian airline hiring forecasts and they suggested that policy makers take these issues into consideration for future hiring plans.

The retention problem of pilots was not only a problem for USAF in the past. The other services have had the same problem and some of them, when compared with the other services, were much more severe. There have been many studies done for the Navy on retention or attrition. As an example, the General Accounting Office (GAO) prepared a report that discussed both external and internal factors to improve military pilot retention in the Navy. According to the GAO, "While all services have some pilot

shortages only the Navy has severe problems. As of September 30, 1979, the Navy had 2,600 (24 percent) fewer pilots than it needed. Pilot shortages in the other services ranged from 1,300 (5 percent) in the Air Force to 700 (18 percent) in the Marine Corps." (GAO, 1980)

In this report, GAO looked at the Aviation Career Incentive Pay (ACIP) program, which covers all military officers with flight duties. GAO explained the ACIP's objectives and stated that, "The program's objectives include creating an equitable system of flight pay, attracting enough candidates for undergraduate pilot training, and, most importantly, inducing these pilots to make the service a career. The services have proposed legislative changes to ACIP to help retain pilots. These changes include a 50-percent increase in flight duty pay for officers and enlisted personnel and added authority to give bonuses" (GAO, 1980).

GAO assessed the causes of shortages in Navy pilots. First of all, greater than normal attrition was one of the major factors behind the Navy's current pilot shortage. According to the report, the Navy was trying to restrain its current pilot shortage by recalling pilots previously released, stopping involuntary pilot separations, and placing higher priority on filling instructor pilot positions to overcome some training shortfalls. Those actions, however, weren't enough to stop attrition. Thus, additional actions should have been taken. Because the consolidation of helicopter pilot training was not approved, DoD should have determined what further steps should have been taken to make sure that the Navy's pilot training program was fully accomplished. Therefore, GAO suggested to the Departments of Defense and the Navy that they also should have written policies and procedures to restrict involuntary separations in those career fields with shortages (GAO, 1980).

On the other hand, the GAO revealed that officers' dissatisfaction about careers in Navy was another crucial factor in the pilot shortage. As GAO stated, dissatisfaction of officers had other aspects of naval aviation, "Officers cited career disincentives, such as

- separation from family,
- decreased flight time,
- overall career dissatisfaction,

- inadequate career counseling,
- unattractiveness of shipboard duty,
- not enough chances for further specialization,
- inflexible assignment and promotion policies,
- decreased chances for advanced education, and
- benefit and retirement uncertainties."(GAO, 1980)

Overall, the GAO concluded that the Navy had the greatest pilot shortage and quick action was needed to improve retention rates. When the flight duty-pay was increased, it should have had some positive effect on retention. On the contrary, we know that the flight duty-pay increase would go to many whose retention was not a primary problem for the services. On the basis of previous experiences, a targeted-bonus would be more useful to improve retention rates in critical shortage occupations, such as pilots. When they need to improve military pilot retention, that kind of targeted-bonus could be used not only by Navy, but also by other services. As GAO mentioned, the most important actions besides targeted bonuses should be to clearly define military pay principles and to train personnel to properly use them (1980).

To investigate the determinants of retention, Coughlin (1996), in his study on Naval aviator retention, used group retention rates for all naval aviators for Fiscal Years 1997 through 1993. He included some internal and external factors in his study to explain retention of Naval aviators. As internal factors, he used the Voluntary Separation Incentive/Selective Separation Bonus (VSI/SSB) program and the Aviation Continuation Pay (ACP) program in his model. As external factors, he used civilian unemployment rates and major airline hiring rates. In contrast to some other studies on aviator retention, Coughlin (1996) used the group logit method to estimate marginal effects of internal and external factors on retention. The author concluded that the unweighted models yield the best results in predicting continuation rates for each of the categories.

Coughlin (1996) found that,

> VSI/SSB, ACP, airline hiring rate and unemployment rate were all statistically significant. The airline hiring rate variable was the only variable which did not have the hypothesized effect on continuation rates.

> Airline hiring rate exhibited a positive relationship with aviator continuation rates in all cases. Unemployment rates were consistently significant and positively related to continuation rates across all communities. (Coughlin, 1996)

In contrast to the study by Elliot, Kapur, and Gresenz (2004), Coughlin found that airline hiring rate variables did not have the hypothesized effect on retention. He also found that "The effect of VSI/SSB program was significant in all but propeller community. The ACP program displayed a positive relationship with continuation rates" (Coughlin, 1996). He recommended that further studies should include civilian airline hiring patterns in their models.

C. RESEARCH QUESTIONS

This thesis analyzes the factors that are associated with separation among United States Air Force (USAF) pilots. Primarily, the determinants of attrition among USAF pilots during their active duty periods were identified. Additionally, this study analyzes whether commissioning source affects the attrition decision of USAF Pilots. By identifying the determinants of separation, the thesis hopes to assist decision makers to reduce losses among Air Force Pilots.

III. DATA AND METHODOLOGY

This chapter describes the data set and the methodology that guides the specification of this study's statistical model. It also provides descriptive statistics for the data set used to estimate the separation model.

A. DATA

The data set used for this thesis was developed from the Active Duty Military Officer File for the Air Force maintained at The Defense Manpower Data Center (DMDC) in Monterey, CA. The data set tracks active duty officers longitudinally through their military careers and it provides information for each person at three different career points: (1) at accession, (2) at the person's most recent information, and (3) at separation for those Air Force officers who leave. Every observation also has both personal and military information. Initial personal information includes a unique ID, education level, marital status, number of dependents, age, and race. Besides personal information, the data set has military information. This includes source of commission, pay grade, Air Force Specialty Code, DoD Occupation Code, current months in grade, and date of current rank. Some of these variables are constant over time, such as gender, race and date of birth. Some of them change over time, such as marital status, number of dependents, and rank. This data set contains observations of Air Force officers who were commissioned between 1992 and 2006.

Before this study converted the original data set into a STATA Software file for statistical analysis, the raw data file had 55,542 observations and 44 columns (data elements). Since this thesis only studied pilot attrition, the data was limited to just pilots of the Air Force (excluding all other line officers, medical, legal, and chaplain personnel). Thus, 36,342 non-line officers were deleted from data set. Further, 5,665 observations were deleted due to missing or unknown values for some data elements, such as current AFSC, race, gender, commissioning source, current education level, current dependents, and current marital status. The resulting data set contained 13,535 observations. Table 1 lists the variables available in the data set.

CATEGORY	VARIABLE LABEL
Demographics	Gender
	Race
	Current Marital Status
	Current Age
	Current Number of Dependents
Professional and Educational Factors	Current Education Level
	Commissioning Source
	Commissioning Date
	Current Months in Grade
	Current AFSC
	Separation Date
	Current Paygrade
	Interservice Separation Code
	Separation Paygrade
	Current DoD Occupation Code

Table 1. Data Elements in the Original DMDC Data File

The objective of this study was to model the effects of education level and commissioning source on separation behavior of Air Force Pilots. To use the data set in determining the probability of staying in the Air Force after the minimum service requirement (MSR), each observation was categorized as a "leaver" or a "stayer." "Leavers" are individuals who voluntarily leave after completing their 8-year initial commitments. The data set is longitudinal. Tracking, however, can only be done on pilots

who were commissioned between 1992 and 1998. Those who were commissioned after 1998 cannot be tracked. This is because the data set has records only through 2006. Thus, it cannot be determined whether officers joining after 1998 left the Air Force after their 8- year initial commitments. After observations were restricted for individuals who cannot be tracked from the data set, a total of 4,251 observations remained for analysis. The number of voluntary leavers and stayers and their percentages are provided in Table 2.

SEPARATION	FREQUENCY	PERCENTAGE (%)
Stayers	3,873	91.11
Leavers	378	8.89
Total	4,251	100.00

Table 2. Frequencies of Stayers and Leavers

B. PRELIMINARY DATA ANALYSIS

1. Dependent and Explanatory Variables

a. Dependent Variable

The dependent variable for the separation model is based on InterService Separation Codes provided by DMDC. These InterService Separation Codes show if an officer separated, the rank at separation, and the reason for the loss. Since the study focuses on the separation of Air Force Pilots, other officer career observations (such as all other line officers, medical, legal, and chaplain personnel) were dropped from the data file. The cut off point was chosen as 8 years of service. This is because a pilot can request to leave from the Air Force after his/her initial 8-year active duty service commitment. A

voluntary separation or release from Air Force is categorized as Separate=1; otherwise Separate=0. The separation codes for leavers, reasons for separation, and number of observations are shown in Table 3.

DMDC Code	DESCRIPTION	FREQUENCY	PERCENTAGE (%)
2001	Expiration of Term of Service	224	59.25
2002	Voluntary Release, to attend school or to teach	0	0
2003	Voluntary release, in the national interest	0	0
2005	Voluntary release, other, including VSI and SSB	154	40.75
Total		378	100

Table 3. Frequencies of Voluntary Separation Codes for Leavers

b. Explanatory Variables

The Officer's personal characteristics and professional backgrounds are included in the explanatory variables. The explanatory variables are categorized into two groups: demographics and professional/educational factors. Demographic variables include gender, race, age, marital status, and number of dependents. Professional/educational factors consist of commissioning source, the highest education level, current months in grade, and current AFSC.

2. Data Description for Stayers and Leavers

Table 4 provides an overview of the characteristics of pilots during their active duty. These statistics were used to give an understanding of the sample and to help formulate hypotheses about the effects of the explanatory variables on pilot separation model.

VARIABLES	**PILOTS N=4251**
	%
Separate (%)	8.89
Gender (%)	
Male	94.42
Female	5.58
Race (%)	
White	96.99
Black	2.75
Other Race	0.26
Current Age (Mean)	
Current Age (Years)	32.75
Marital Status (%)	
Married	83.13
Not Married	16.87
Dependents (%)	
One or No Dependent	38.13
Two Dependents	20.37
Three Dependents	26.70
Four Dependents or More	14.80
Commissioning Source (%)	
USAFA	42.13
ROTC	47.47
OTS and Other Sources	10.40
Current Months in Grade (Mean)	
Current Months in Grade	39.51
Current Education Level (%)	
Less than Bachelor's Degree	0.24
Bachelor's Degree	68.74
Master's Degree or Above	31.03

Table 4. Descriptive Statistics of Pilots at Year 2006

Table 4 shows the distribution of pilots by demographic characteristics. The majority of pilots (94.42 percent) are males, white (96.99 percent), and married (83.13 percent) with two or more dependents (61.87 percent). The average age is 32.75.

Table 5 shows the demographic (gender, race, current age, marital status and dependents) and professional/educational (commissioning source, months in grade and current education) distribution of leavers and stayers.

VARIABLES	**"LEAVERS" N=378**	**"STAYERS" N=3873**
Gender (%)		
Male	8.52	91.48
Female	15.16	84.84
Race (%)		
White	8.75	91.25
Black	14.52	85.48
Other Race	0	100
Current Age (Mean)		
Current Age (Years)	30.28	32.99
Marital Status (%)		
Married	7.13	92.87
Not Married	17.57	82.43
Dependents (%)		
One or No Dependent	14.12	85.88
Two Dependents	7.50	92.50
Three Dependents	5.90	94.10
Four or More Dependents	2.70	97.30
Commissioning Source (%)		
USAFA	6.86	93.14

VARIABLES	**“LEAVERS” N=378**	**“STAYERS” N=3873**
ROTC	9.66	90.34
OTS and Other Sources	13.57	86.43
Current Months in Grade (Mean)		
Current Months in Grade	44.97	38.98
Current Education (%)		
Less than Bachelor’s Degree	33.33	66.67
Bachelor’s Degree	11.09	88.91
Master’s Degree or Above	3.87	96.13

Table 5. Distribution of "Leavers" and "Stayers" by Background Characteristics

Figure 1 indicates that the majority of pilots are accessed through ROTC, followed by USAFA, and then OTS and other programs at 47.47 percent, 42.13 percent, and 10.40 percent, respectively. As expected, this data supports the information that ROTC is the largest commissioning source of the Air Force as summarized in the literature review. The educational statistics show that pilots holding a Bachelor’s Degree are the majority of population at 68.74 percent, while Master’s Degree or above comprise only 31.03 percent of the population. Current Months in Grade shows that, on average, pilots have almost 40 months service experience in their current grades.

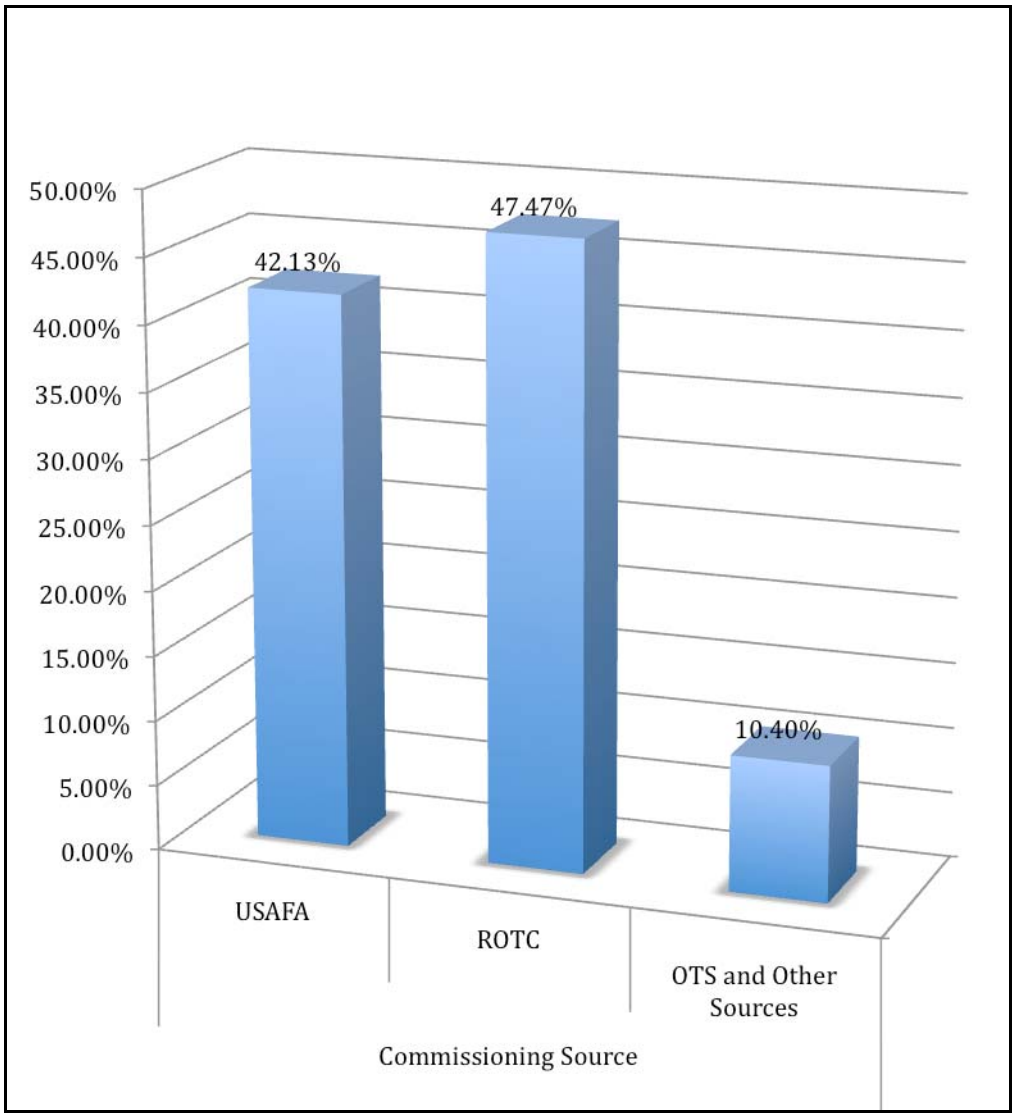
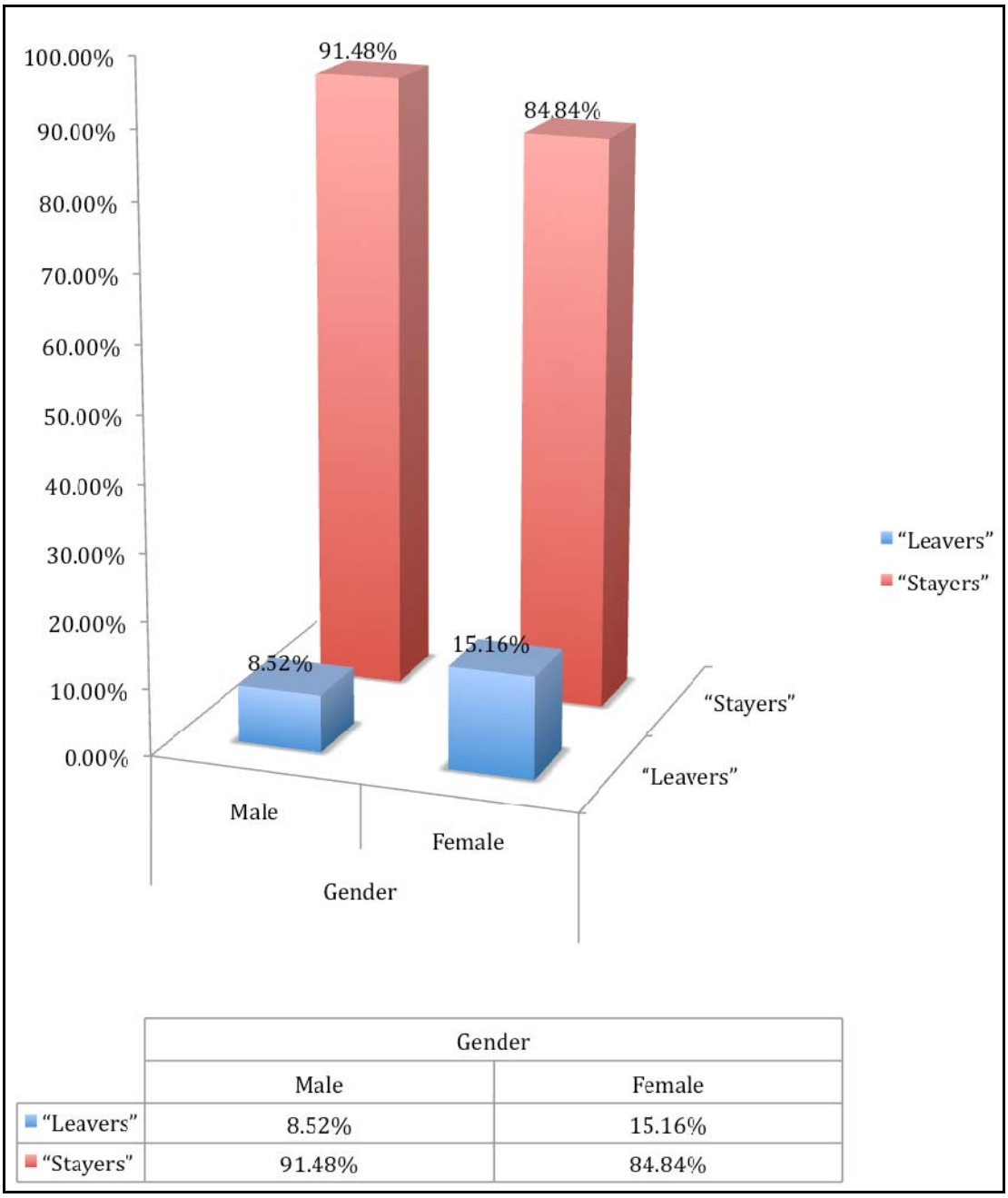


Figure 1. Distribution of Pilots by Commissioning Source

Figure 2 illustrates that a larger percentage of women choose to leave the Air Force than men, 15.16 percent versus 8.52 percent. That difference between men and women could be explained in part by the decisions of some women to separate to pursue civilian opportunities or to raise families at the end of their initial commitment.



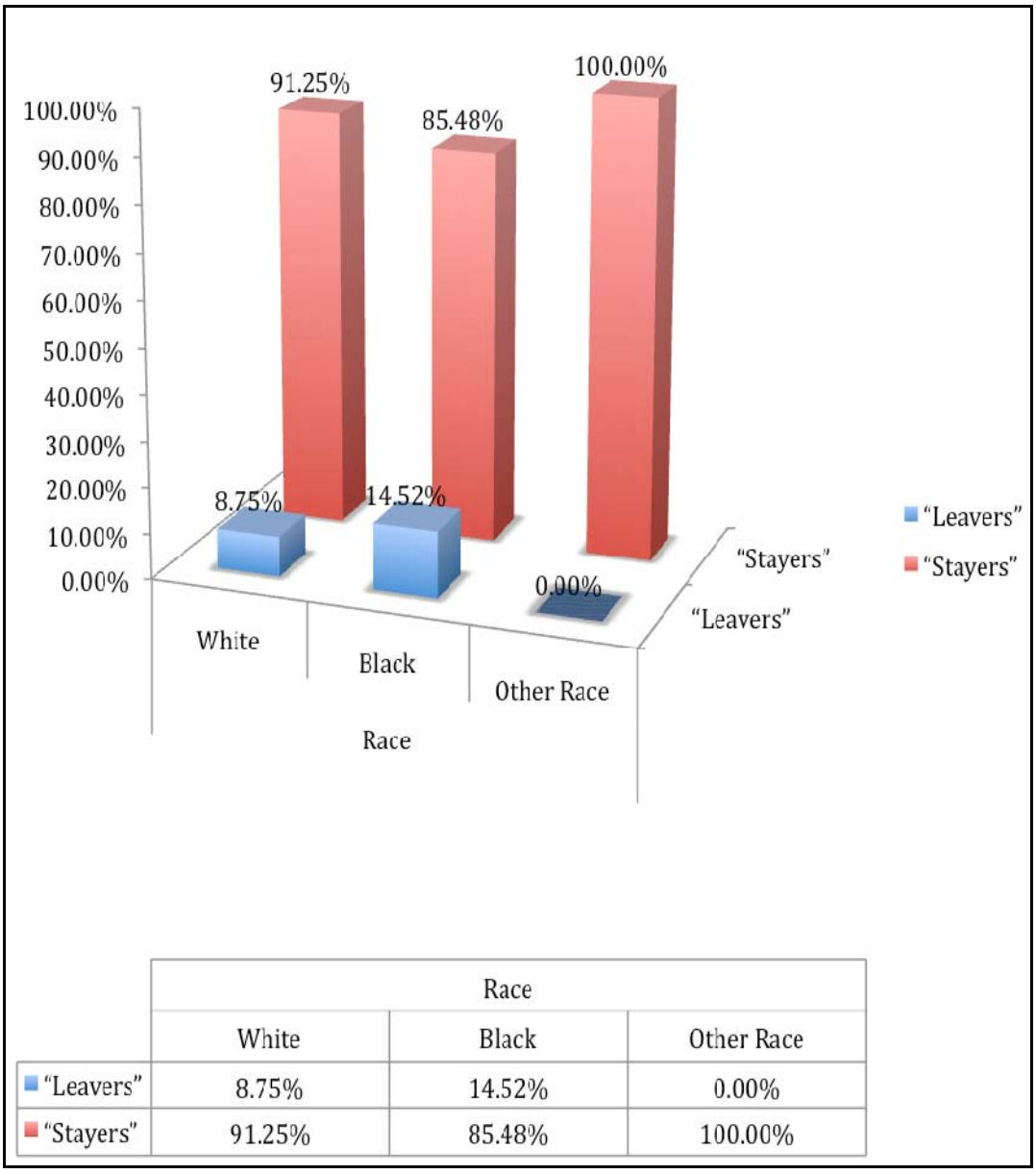
	Gender	
	Male	Female
"Leavers"	8.52%	15.16%
"Stayers"	91.48%	84.84%

Figure 2. Distribution of Separation by Gender

Figure 3 shows that blacks have a higher separation rate compared to whites, 14.52 percent versus 8.75 percent. Surprisingly, the separation model shows that all non-

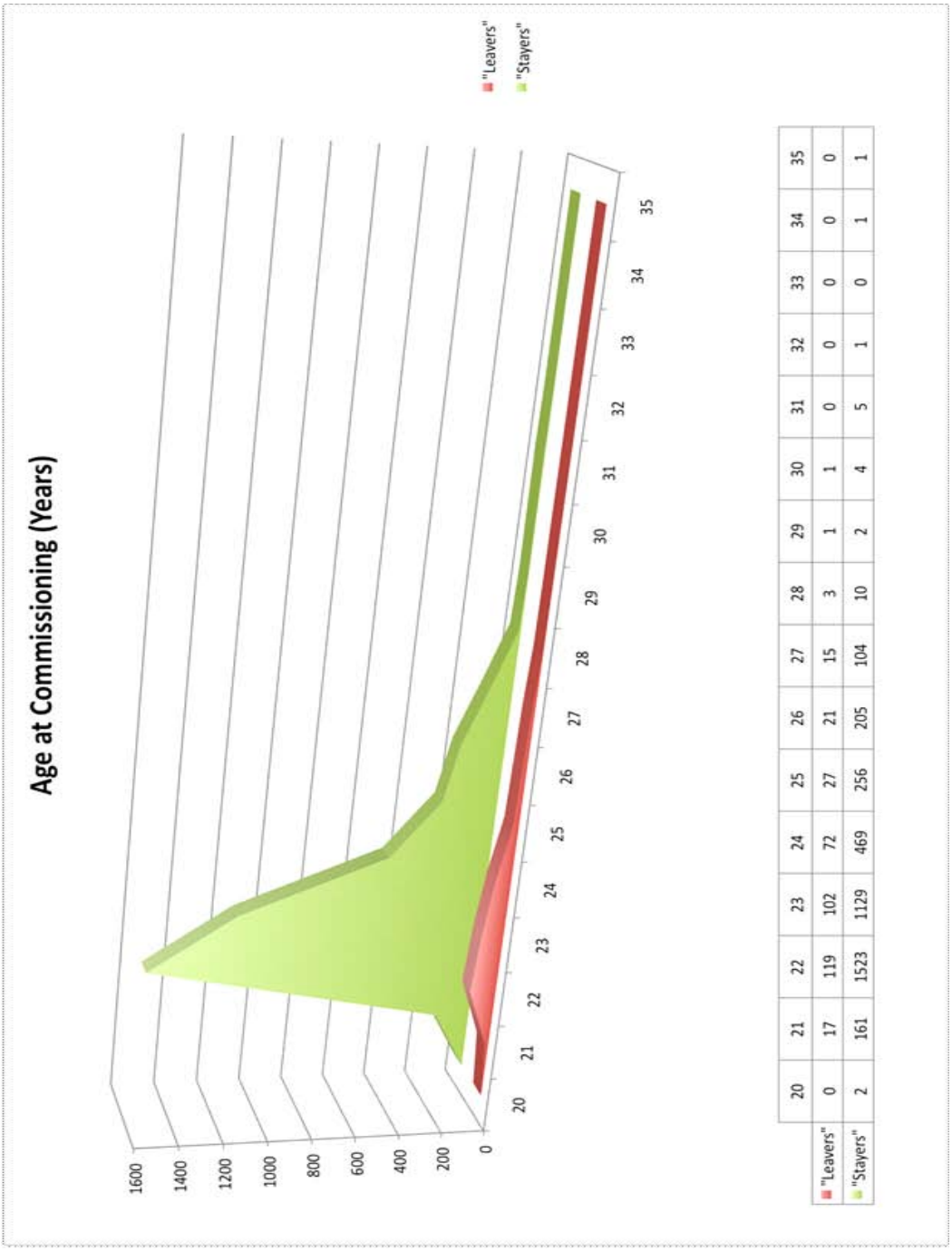
black minorities wanted to stay in Air Force after their 8-year initial commitments. The small proportion of non-black minorities in the data set compared to blacks could explain this high retention rate.

Figure 4 shows the distribution of both leavers and stayers by age at commissioning. Age varies from 20 to 35 and indicates a large number of leavers were commissioned between ages 22 and 24. As seen in Table 5, current age shows that pilots, on average, choose to leave at age 30. From these two variables, it can be assumed that a pilot, on average, enters Air Force when he is 22 years old and leaves when he is 30 years old. This also means that he leaves after his initial 8-year active duty service commitment.



	Race		
	White	Black	Other Race
"Leavers"	8.75%	14.52%	0.00%
"Stayers"	91.25%	85.48%	100.00%

Figure 3. Distribution of Separation by Race (%)

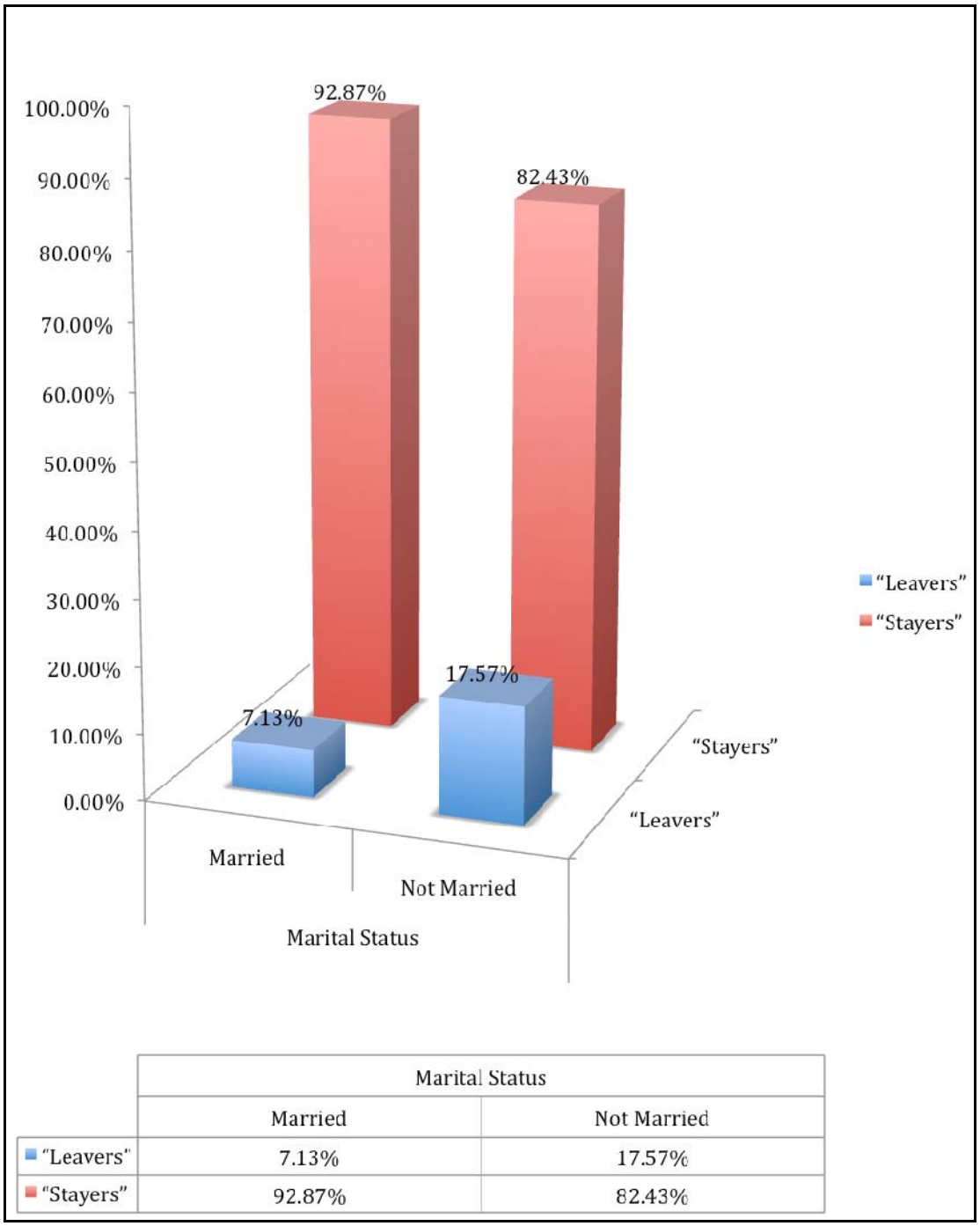


	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
"Leavers"	0	17	119	102	72	27	21	15	3	1	1	0	0	0	0	0
"Stayers"	2	161	1523	1129	469	256	205	104	10	2	4	5	1	0	1	1

Figure 4. Age at Commissioning (Years)

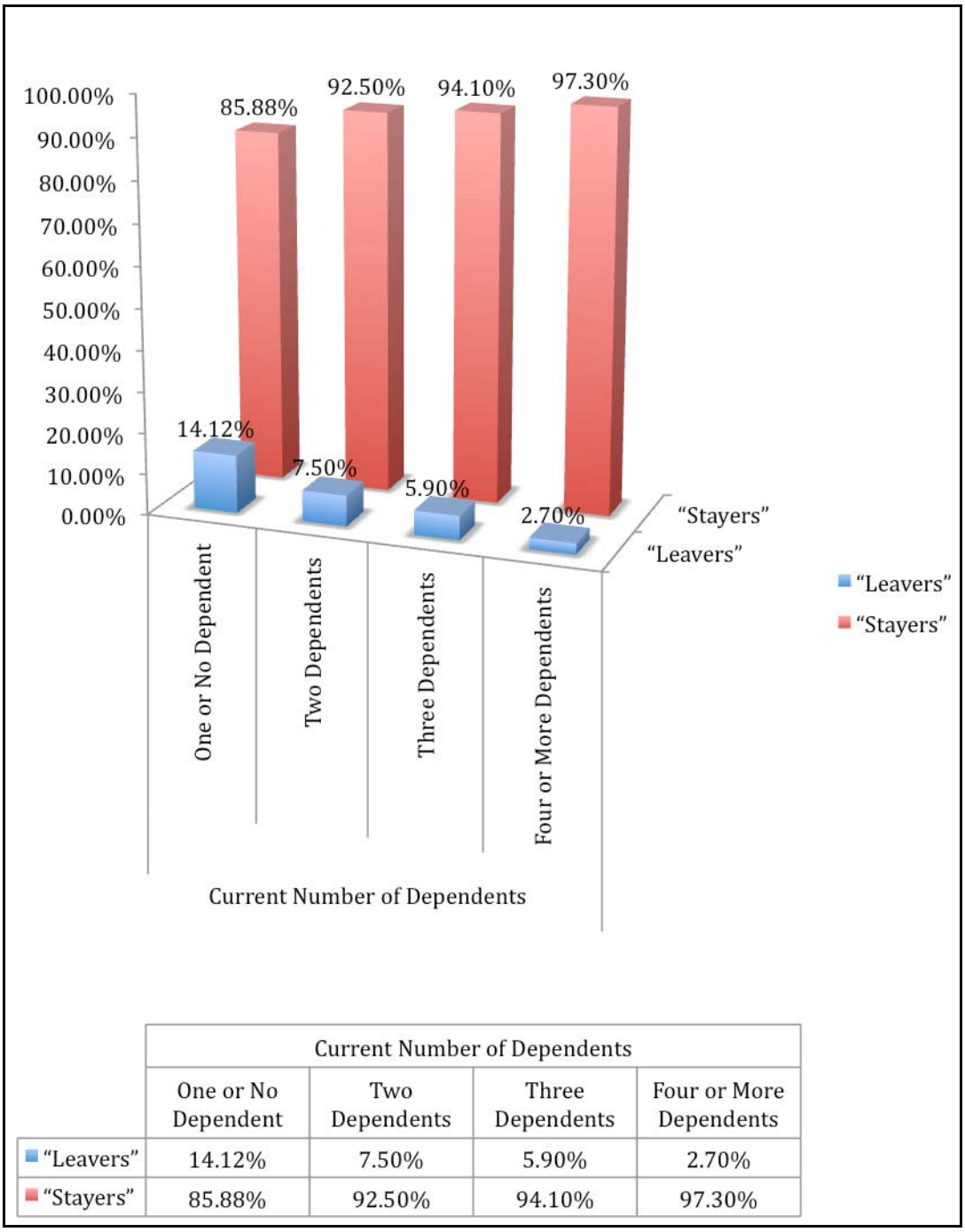
Figure 5 illustrates that single pilots leave at a higher rate than married pilots, 17.57 percent versus 7.13 percent. Figure 6 shows that pilots with one or no dependents

are also more likely to leave at 14.12 percent, as compared to their peers who have two, three, and four or more dependents at 7.50 percent, 5.90 percent, and 2.70 percent, respectively. Both the number of dependents and marital status show that these factors may have more influence on the separation behavior of pilots than other demographic factors.



	Marital Status	
	Married	Not Married
"Leavers"	7.13%	17.57%
"Stayers"	92.87%	82.43%

Figure 5. Distribution of Separation by Marital Status (%)

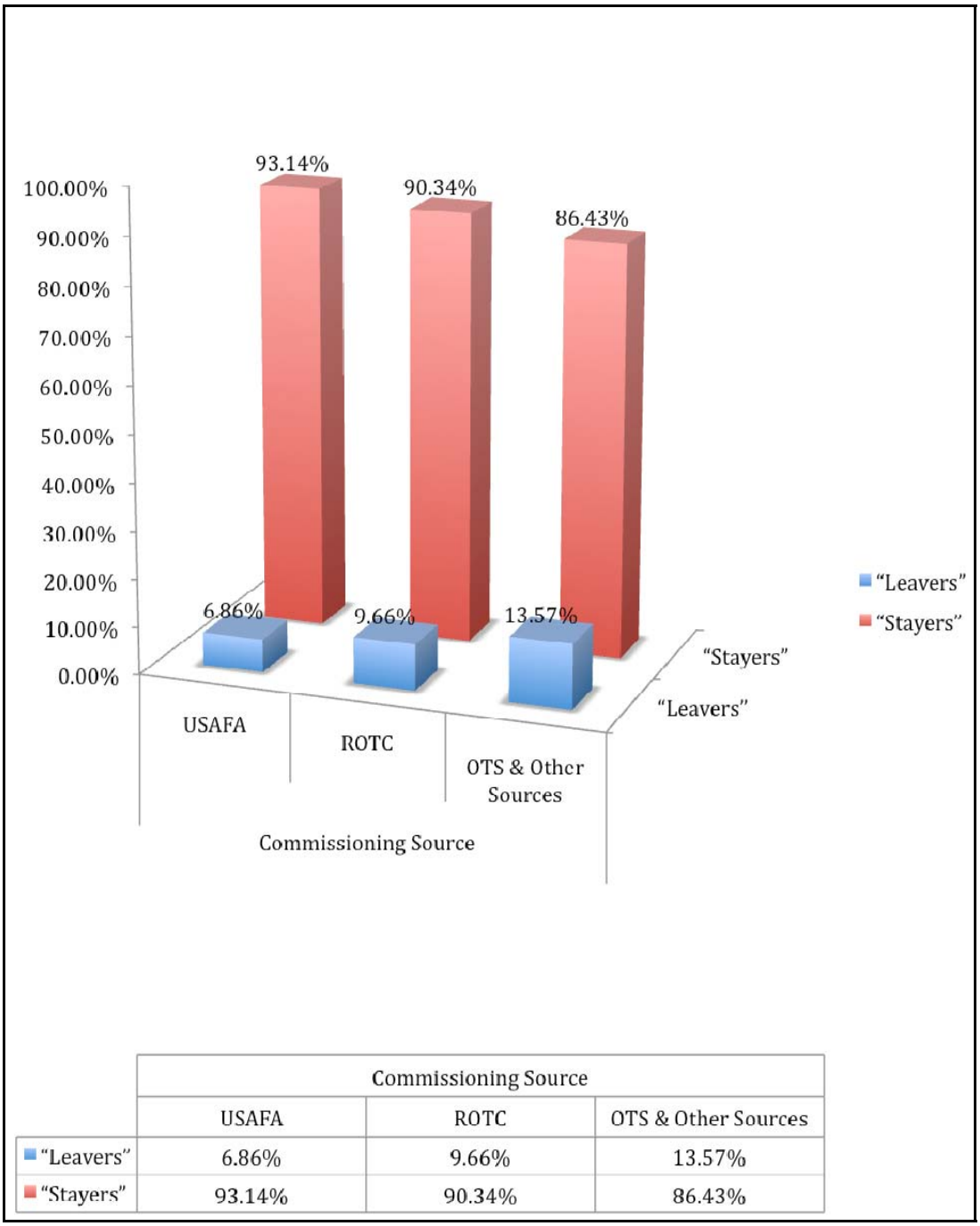


	Current Number of Dependents			
	One or No Dependent	Two Dependents	Three Dependents	Four or More Dependents
"Leavers"	14.12%	7.50%	5.90%	2.70%
"Stayers"	85.88%	92.50%	94.10%	97.30%

Figure 6. Distribution of Separation by Number of Dependents (%)

Figure 7 illustrates that pilots who received their commission at the USAFA have the lowest separation rate at 6.86 percent, followed by ROTC at 9.66 percent, and OTS and other programs at 13.57 percent. While the initial commitments for these groups are

the same, eight years, any differences between the commission sources could be explained by taste for military lifestyle, with USAFA graduates possibly having a higher propensity for the military lifestyle based on their 4-year academy education. Also, USAFA graduates could be more motivated to stay in the Air Force because they have already experienced what they will experience on active duty. Surprisingly, while they might have previous enlisted experience, graduates from OTS and other programs had the highest separation rate. Current months in grade indicates that pilots selecting to leave have almost 45 months of service in that current grade, which means they stayed in the Air Force almost 4 years after their initial 8-year commitments.

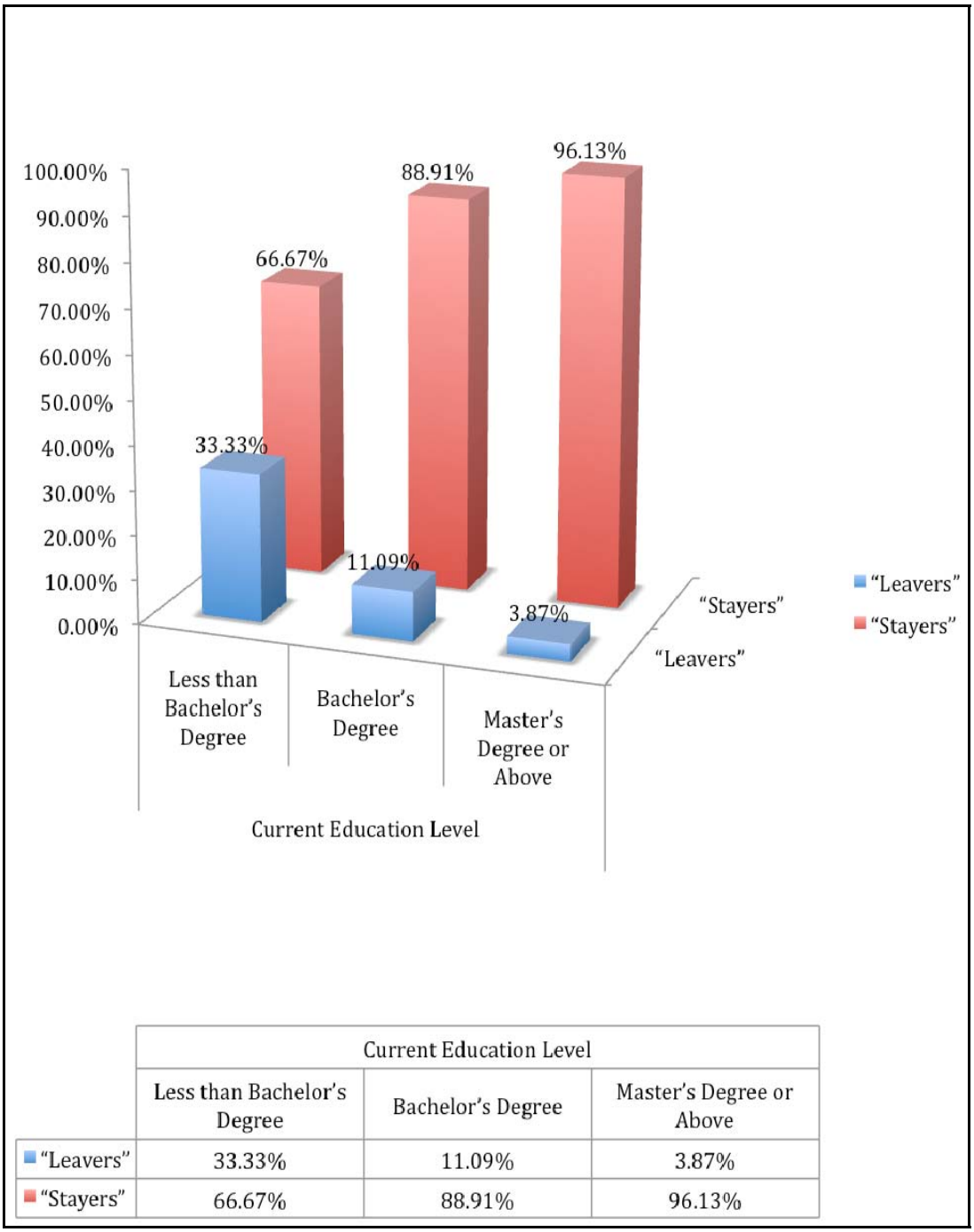


	Commissioning Source		
	USAFA	ROTC	OTS & Other Sources
"Leavers"	6.86%	9.66%	13.57%
"Stayers"	93.14%	90.34%	86.43%

Figure 7. Distribution of Separation by Commissioning Sources (%)

Figure 8 shows that 11.09 percent of pilots with Bachelor Degrees choose to leave the Air Force, while only 3.87 percent of pilots with Master's Degree or above choose to leave. On the other hand, pilots with less than a Bachelor's Degree have the lowest retention rate compared to their peers. It could be explained by the small sample size of

those pilots. As can be seen in Figure 8, pilots holding an advanced degree have the highest retention rate. These statistics may indicate that possession of an advanced degree could serve as a retention tool for the Air Force. In general, an additional commitment of two years is required for individuals using tuition assistance, while those attending in-residence graduate programs owe three years. Thus, accepting graduate education could be a signal of intent to stay. Often, lack of an advanced degree will reduce promotion prospects. As Kahraman (2007) mentioned in his thesis, officers possessing an advanced degree are more likely to be promoted. It is also known that employees with firm-specific training tend to stay in their fields or industries because their particular skills might only be applicable in these fields; however, this is not a big issue for pilots (Ehrenberg & Smith, 2009).

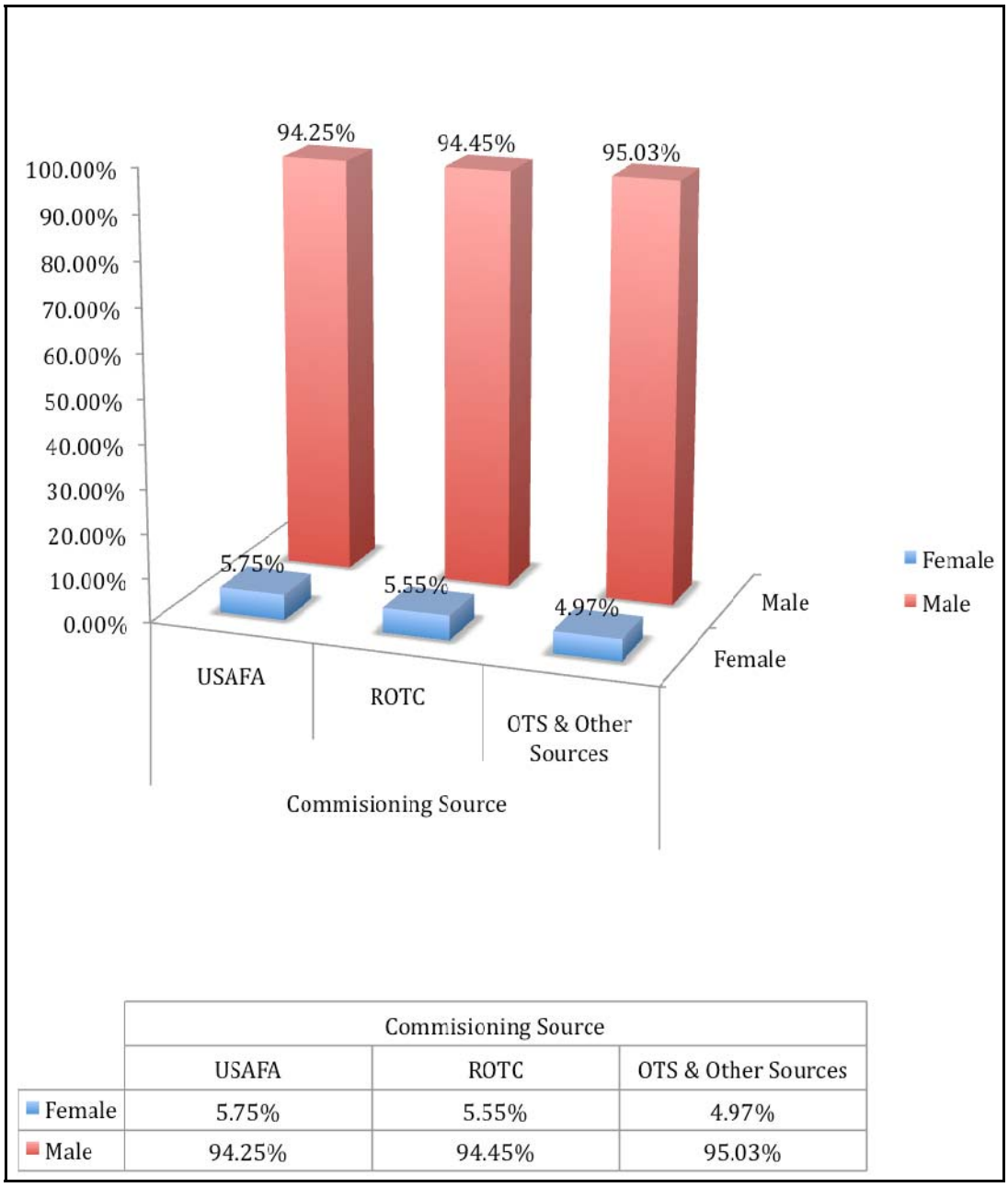


	Current Education Level		
	Less than Bachelor's Degree	Bachelor's Degree	Master's Degree or Above
"Leavers"	33.33%	11.09%	3.87%
"Stayers"	66.67%	88.91%	96.13%

Figure 8. Distribution of Separation by Education Level (%)

Regarding commissioning sources, Figure 9 displays the distribution in percentages of commissioning source by gender. The results indicate that the largest proportion of female accession comes from USAFA at 5.75 percent, followed closely by

ROTC at 5.55 percent, and OTS and other programs at 4.97 percent. For this study's sample, when female accession is considered, these results indicate that USAFA stands at first place.



	Commisioning Source		
	USAFA	ROTC	OTS & Other Sources
Female	5.75%	5.55%	4.97%
Male	94.25%	94.45%	95.03%

Figure 9. Distribution of Commissioning Sources by Gender (%)

C. METHODOLOGY

The purpose of this thesis was to analyze the factors that explain the separation behavior of the Air Force pilots. Additionally, this study analyzed whether commissioning source affects separation. Data for USAF pilots who were commissioned between 1992 and 1998 was utilized.

The study utilized logistic regressions models to measure the determinants of separation. Since the dependent variable used in the separation model in this study is binary, logistic regression models are appropriate as a tool for analysis.

1. Theoretical Model

The sample group was retrieved from the database based on year of entry (commission) for officers between 1992 and 2006. In this study's model, the dependent variable "Separate" is a binary variable. To overcome the limitations of the Linear Probability Model (LPM), the logistic regression (LOGIT) model was used. The LPM is easy to use, but it has some disadvantages. For example, in LPM, the estimated predicted probabilities can be less than zero or greater than one. Also, in LPM, the partial effects of independent variables are constant. In a LOGIT model, the dependent variable is binary and the general equation may be written as follows:

$$P(y=1|x) = P(y=1|x_1, x_2,\ldots., x_k),$$

In this model, x represents explanatory variables and y represents the dependent variable. It was assumed that the response probability was linear. To avoid the limitations of LPM, a class of binary response models of the form was considered:

$$P(y=1|x) = G(\beta_o + \beta_1 x_1 + \beta_2 x_2 + \ldots.. + \beta_k x_k = G(\beta_o + x\beta),$$

where G is a function taking on values strictly between zero and one. $0<G(z)<1$ for all real numbers z. This ensures that the estimated response probabilities are strictly between zero and one. In the LOGIT model, G is the logistic function, which is the normal cumulative distribution function for a standard logistic random variable:

$$G(z) = \exp(z) / [1 + \exp(z)] = \Lambda(z)$$

which is between zero and one for all real numbers. (Wooldridge, 2009)

This case is referred to as a LOGIT model or, sometimes, as a logistic regression. The function has an increasing curve in z. Since it is nonlinear, the LOGIT model requires maximum likelihood estimation (MLE). Maximum likelihood estimation computes parameters that maximize the probability of observing what was actually observed.

The estimated coefficients of the explanatory variables give the magnitude and the sign of the effects of each explanatory variable on the dependent variable. A positive sign of a coefficient indicates that an increase in x is associated with an increase in the probability of separation. Conversely, a negative sign of an estimated coefficient indicates a decrease in the probability of separation as x increases. This study used STATA data analysis software to run the regressions.

2. LOGIT Model

The separation model used the binary variable "Separate" as the dependent variable in the logistic regressions. "Separate" was set equal to '1' if a pilot leaves the Air Force after completing his/her initial service; otherwise '0.' The specification of the separation model is as follows:

$$\ell n\,(\text{Separate}) = \beta_0 \text{Age\_Comm} + \beta_1 \text{Female} + \beta_2 \text{Not\_Married} + \beta_3 \text{Black} + \beta_4 \text{Other\_Race} + \beta_5 \text{MasterORhigher} + \beta_6 \text{Less\_BA\_Degree} + \beta_7 \text{Dpndt\_2} + \beta_8 \text{Dpndt\_3} + \beta_9 \text{Dpndt\_4} + \beta_{10} \text{USAFA} + \beta_{11} \text{OTS\_and\_Other} + \beta_{12} \text{Curr\_MIG} + \varepsilon$$

where,

Age_Comm = Commissioning age

Female = Gender is female

Not_Married = Individual is single or no longer married

Black = Race is black

Other_Race = Race is other than white or black

MasterORhigher = Education level is Master's Degree or higher

Less_BA_Degree = Education level is less than Bachelor's Degree

Dpndt_2 = Number of dependents is two

Dpndt_3 = Number of dependents is three

Dpndt_4 = Number of dependents is four or more

USAFA = Commissioned through USAFA

OTS_and_Other = Commissioned through OTS or other programs

Curr_MIG = Current months in grade.

3. Dependent and Independent Variables

The dependent variable used for the separation model was based on voluntary separation at 8 years of service point.

Independent variables were extracted from raw data and, based on the literature review, are considered to be predictors of Air Force pilot separation. The independent variables used in this model are described below.

AGE (Age_Comm): To calculate the "Age_Comm" variable, the date of birth was subtracted from the commissioning date. This number was then divided by 365 to find age at commissioning. The age at commissioning varies from 20 to 35. The authors of this thesis expect that officers who are commissioned at older ages will be more willing to stay since career change decisions are more difficult in older ages. The Age_Comm variable is expected to have a negative effect on separation.

GENDER: The authors decided to keep female pilots in the sample data. Female pilots, however, represent only 6 percent of the sample. From previous studies (e.g.,

Fullerton, 1999), it is known that female pilots are more likely to leave after their initial service commitment, often because of family reasons. This study's authors expect that the effect of being female will be positive on separation.

RACE: Race is divided into three categories: White, Black, and Other_Race. Since white pilots are the majority in this study's sample, the base category is white. It is considered that there may be slight differences between white pilots and black pilots in terms of the separation decision. It is expected that Other_Race variable may have a positive retention effect. This is because military career is mostly a better choice for minorities.

EDUCATION LEVEL: Education level is divided into three categories: Bachelor's Degree (BA_degree), less than Bachelor's Degree (Less_BA_degree), and Master's Degree or higher (MasterORhigher). Since pilots with BA Degree are the vast majority, BA_degree was used as base case in the sample data. Like other services, the Air Force also invests in human capital by providing educational opportunities to its personnel. According to human capital theory, education has positive effects on retention. It may be considered that pilots with higher education will be more attractive to the civilian sector (Albrecht, 1976). On the other hand, investment in human capital may improve loyalty. Parallel to previous studies, however, it is expected that "MasterORhigher" will have negative and "Less_than_BA" will have positive effects on separation.

MARITAL STATUS: Marital status is divided into two categories: "Married" and "Not_Married.". In the sample, the base case is "Married" since married pilots are the majority. Married people generally have a more stable lifestyle and they are considered to be non-risk takers compared to singles (Chun and Lee, 2001). Even if there may be better opportunities for pilots in the civilian sector, married pilots may be more willing to stay because of family issues and job stability. Because of the reasons mentioned above and previous studies, it is expected that being single (or no longer married) will have a positive effect on separation compared to being married (base case).

DEPENDENTS: Dependents are categorized into four groups: Dpndt_0or1 (individual having one or no dependents), Dpndt_2 (individual having two dependents), Dpndt_3 (individual having three dependents), and Dpndt_4 (individual having four or more dependents). In the sample, "Dpndt_0or1" is the base case since pilots with one or no dependent are the majority. It is assumed that pilots with more dependents are more likely to stay compared to those who have fewer dependents due to family issues and desire for job and income stability. Therefore, it is expected that the effect of having more dependents will be negative on separation.

COMMISSIONING SOURCE: Commissioning source is divided into four categories: USAFA, ROTC, OTS, and Other. In the sample data, ROTC is the base case since most pilots are commissioned via ROTC. The results of these variables will help to analyze the secondary objective of this thesis. For decision makers, it is critical to be able to determine the differences among commissioning sources in terms of retention. It is difficult to predict whether these variables will have a positive or negative effect on separation decisions. Therefore, it is expected that findings will be similar to the results in the previous studies. Previous studies (Elliot, Kapur, and Gresenz, 2004; Lu, 1995) find that pilots commissioned through USAFA are more likely to stay compared to those who are commissioned through ROTC, OTS, or other programs.

CURRENT MONTHS IN GRADE: This variable measures the months of service a pilot has accrued at his/her grade. Also, it measures the length of time that a pilot invested with the Air Force in the current grade. It may be expected that pilots will be less likely to stay as the months in grade increase. Therefore, the expected sign of "C_MIG" will be positive.

Table 6 summarizes the dependent and independent variables and their expected effects on separation. Positive expected effects imply that increases in the independent variable increase the probability of leaving, while negative expected effects imply increases in the independent variable decrease the probability of leaving.

DEPENDENT VARIABLE	DUMMY VARIABLE	DESCRIPTION	EXPECTED EFFECT
Separate			
INDEPENDENT VARIABLES			
Age		Age at Commissioning	Negative
Race	White	Race is white	Base Category
	Black	Race is black	Negative
	Other_Race	Race is other than white or black	Negative
Gender	Male	Gender is male	Base Category
	Female	Gender is female	Positive
Marital Status	Married	Individual is married	Base Category
	Single	Individual is single	Positive
Number of Dependents	Dpndt_0or1	Number of dependents is zero or one	Base Category
	Dpndt_2	Number of dependents is two	Positive
	Dpndt_3	Number of dependents is three	Positive
	Dpndt_4	Number of dependents is four	Positive
Education Level	BA_Degree	Education level is Bachelor's Degree	Base Category
	Less_BA_Degree	Education level is less than Bachelor's Degree.	Positive
	MasterORhigher	Education level is Master's Degree or higher	Negative
Commissioning Source	USAFA	Commissioning source is USAFA	Base Category
	ROTC	Commissioning source is ROTC	Positive
	OTS_and_Other	Commissioning source is OTS or other	Positive
Months in Grade	Curr_MIG	Current Months in Grade	Positive

Table 6. Dependent and Independent Variables and Descriptions

IV. RESULTS OF THE STATISTICAL ANALYSIS

A. OVERVIEW

Logistic regression models were estimated to explain the separation behavior of Air Force pilots. The binary dependent variable "Separate" was used in the logistic regressions.

As explanatory variables, the logistic regression model included age at commissioning, gender, race, education level, marital status, number of dependents, commissioning source, and months in grade. The estimated coefficients of the explanatory variables give the sign of each explanatory variable on separation. The partial effects were calculated by using the estimated coefficients from the logistic regression. The STATA data analysis program was used to run the regressions and estimate the partial effects.

B. MODEL RESULTS

The separation model analyzes the determinants of separation behavior. This model examines the effect of age at commissioning, gender, race, education level, marital status, number of dependents, commissioning source, and months in grade on separation. The sample used for regressions included 4,251 Air Force pilots, of which 3,873 stayed in the Air Force after the initial service commitment, and 378 voluntarily separated from the Air Force after the end of initial service commitment. The attrition rate for the sample used for regressions is 8.89 percent. Table 7 shows the likelihood ratio, p-value, coefficients (maximum likelihood estimates), standard errors, and significance level of the explanatory variables.

SEPARATION MODEL		
Dependent Variable: Separate **Number of Observations: 4,240**		
Independent Variables	**Coefficients**	**Standard Errors**
Age_Comm	0.1144856	0.0367412***
Female	0.3518176	0.1996107*
Not_Married	0.4705249	0.1421882***
Black	0.716346	0.2806743**
MasterORhigher	-0.9064452	0.1585098***
Less_BA_Degree	1.110972	0.7163395
Dpndt_2	-0.4795429	0.1664987***
Dpndt_3	-0.6467419	0.167191***
Dpndt_4	-1.518586	0.2719844***
USAFA	-0.3545405	0.1266514***
OTS_and_Other	0.276786	0.1818011
Curr_MIG	0.0101127	0.0025636***
Intercept	-4.897479	0.8665684***
Likelihood Ratio Statistic = -1162.2104 **Degrees of Freedom = 13** **p-value = 0.0000**		
Pseudo R-squared = 0.0880		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Table 7. The Separation LOGIT Model Results

Goodness-of-fit measures were used to validate the separation model. Goodness-of-fit measures indicate how well the explanatory or independent variables explain the dependent variable. It tests weather the explanatory variables in the model explain the variation observed in the dependent variable. The null hypothesis states that all of the coefficients of explanatory variables are zero and have no effect on the dependent variable. The alternative hypothesis states that at least one of the explanatory variables explains the variation observed in the dependent variable. Pseudo R-squared for a logit model is directly related to the usual R-squared from Ordinary Least Squares (OLS) estimation of a linear probability model. The pseudo R-squared value quantifies goodness-of-fit. Higher values of the pseudo R-squared (.088) indicate that the model fits the data well. The likelihood-ratio test rejects the null hypothesis if the value of this statistic is too small (Wooldridge). In the separation model, there was enough evidence to reject the null hypothesis since the Likelihood Ratio Statistic is -1162.2 and the Degrees of Freedom is 13 and the prob > chi-squared is 0.0. It means that at least one of the explanatory variables explains the dependent ("Separate") variable.

1. Interpretation of the Coefficients

There were 13 explanatory variables in the separation model, including dummy variables created for some categories. The coefficients of dummy variables were assessed with respect to the base case for each category. In the separation model, all the variables were significant, except the "OTS_and_Other" and "Less_BA_Degree" variables. Parameter estimates and significance levels are shown above in Table 7.

The "Age_Comm" explanatory variable was statistically significant at 1 percent. It also indicated that this variable has a positive influence on the separation decision. An increase in age at commissioning increased the probability of separation decision after the initial service commitment. It can be concluded that the officers who are commissioned at older ages are more likely to separate from the Air Force. This result contradicts with the expected effect. It may be considered, however, that pilots commissioned at older ages might be at retirement age after finishing their initial service commitments.

The “Female” dummy variable was statistically significant at 10 percent. It also indicates that this variable has a positive influence on separation decision. It can be concluded that being female increases the probability of leaving. The result is consistent with the hypothesized effect and parallel to the findings of relevant studies discussed in the literature review.

The “Not_Married” dummy variable was statistically significant at 1 percent. It has a positive sign and indicates that pilots who are not married (single) are less likely to stay in the Air Force after the initial service commitment compared to those who are married. It can be concluded that being single increases the probability of leaving. This finding is also consistent with the hypothesized effect and parallel to the findings of the studies discussed in the literature review.

The “Black” dummy variable was statistically significant at 5 percent. It has a positive sign and it indicates that black pilots are less likely to stay compared to whites. It can be concluded that being black increases the probability of separation decision. This finding is parallel to the findings of previous studies discussed in the literature review. In the separation model, the “Other_Race” dummy variable was dropped. This was because there were few observations and none of them separated after initial service commitment. The results, however, indicate that minorities (“Black” and “Other_Race”) are more likely to stay compared to white pilots.

The “MasterORhigher” dummy variable was statistically significant at 1 percent. It has a negative sign and it indicates that the pilots with Master’s Degrees or a higher degree are more likely to stay compare to those who have only a Bachelor’s Degree. It can be concluded that having Master’s Degree or a higher degree decreases the probability of separation. Another education-level dummy variable included in the separation model was “Less_BA_Degree.” This dummy variable is not statistically significant since there are few pilots having less than a Bachelor’s Degree in sample. It had a positive sign, but it cannot be concluded that the pilots having less than Bachelor’s Degrees are less willing to stay, since it was not statistically significant. Overall, the results are consistent with the hypothesized effects and previous studies discussed in the literature review.

All of the dummy variables that represent number of dependents, “Dpndt_2,” “Dpndt_3,” and “Dpndt_4,” are statistically significant at 1 percent. They all have negative signs, meaning that pilots with more dependents are more likely to stay in the Air Force after the initial service commitment. These findings also support the hypothesized effects.

The commissioning source variables, “USAFA” and “OTS_and_Other,” are included in the separation model, while the base case is ROTC. “USAFA” is statistically significant at 1 percent and “OTS_and_Other” is not statistically significant. The “USAFA” dummy variable has a negative sign, while “OTS_and_Other” has a positive sign. Pilots commissioned through the U.S. Air Force Academy are more likely to stay after initial service commitment compared to those who commissioned through ROTC. “OTS_and_Other” has a positive sign, but we cannot conclude that pilots commissioned through OTS and other programs are less likely to stay. This is because the coefficient is not statistically significant. ROTC and USAFA are the primary commissioning sources for pilots, so these results indicate that the pilots commissioned through the USAFA stay at the higher rates than those who are commissioned through ROTC. These results also support the hypothesized effect.

The current months in grade variable, “Curr_MIG,” is significant at 1 percent. It has a positive sign and it indicates that pilots are less likely to stay as the months in grade increases. This finding supports the hypothesized effect.

2. Partial Effects

The partial effects are interpreted with respect to the base cases. In the separation model, the base case is a pilot who is at average age of 32.75, male, married, white, with one or no dependents, with Bachelor’s Degree, and commissioned through ROTC. The partial effects estimation indicates that the probability of separation from the Air Force after initial service commitment for the base case (average) pilot is 6.7 percent.

Partial effects estimation for the separation model indicates that all demographic variables are statistically significant. Being one year older than the average age increases

the probability of separation by 1.15 percent. A female pilot with the same characteristics at the base case has a 3.5 percent higher probability of separation from the Air Force. A black pilot has a 7.16 percent lower probability of separation compared with a white pilot with the same characteristics. A single pilot has a 4.70 percent higher probability of separation compared to those who are married with the same characteristics. Pilots with two, three, four or more dependents have 4.79 percent, 6.46 percent, and 15.18 percent higher probability of separation compared to base case, respectively.

The "MasterORhigher" education level variable is statistically significant, while "Less_BA_Degree" variable is insignificant. A pilot with a Master's Degree or a higher degree has a 9.0 percent lower probability of separation compared to the base pilot with Bachelor's Degree. The "USAFA" commissioning source variable is significant, while OTS_and_Other is statistically insignificant. Pilots commissioned through the Air Force Academy have a 3.45 percent lower probability of separation compared to pilots commissioned through ROTC. The "Curr_MIG" variable that represents current months in grade is statistically significant. A one-month increase in months accrued increases the probability of separation by 0.1 percent.

MARGINAL EFFECTS FOR THE SEPARATION MODEL			
Dependent Variable: Separate **Number of Observations: 4,240**			
Independent Variables	**Coefficients**	**Standard Errors**	**Prob > Chi-squared**
Age_Comm	0.1145	0.0367	0.00***
Female	0.3518	0.1996	0.12*
Not_Married	0.4705	0.1422	0.00***
Black	0.7163	0.2807	0.04**
MasterORhigher	-0.9064	0.1585	0.00***
Less_BA_Degree	1.1110	0.7163	0.28
Dpndt_2	-0.4795	0.1665	0.00***
Dpndt_3	-0.6467	0.1672	0.00***
Dpndt_4	-1.5186	0.2720	0.00***
USAFA	-0.3545	0.1267	0.00***
OTS_and_Other	0.2768	0.1818	0.16
Curr_MIG	0.0101	0.0026	0.00***
Intercept	-4.8975	0.8666	0.00***
Predicted Probability for the Base Case = .06732931			
*** significant at 10%; ** significant at 5%; *** significant at 1%**			

Table 8. Partial Effects of the Explanatory Variables for the Separation Model

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V. CONCLUSIONS

A. OVERVIEW

This study sought to demonstrate the effects of demographics and professional military background on the separation of U.S. Air Force (USAF) pilots. Initially, this study determined that demographics have important influences on the separation behavior of USAF pilots. It also highlights that professional factors, such as advanced education, improves pilot retention. This study also sought to investigate the effects of commissioning sources on separation behavior of USAF pilots.

1. Primary Research Question

The primary purpose of this thesis was to determine the effect of demographic background and education on the separation rate of USAF pilots. To analyze separation, this thesis used a sample comprised of pilots commissioned between 1992 and 2006.

Those variables (except "Less_BA_Degree" and 'OTS_and_Other") included in the separation model were found to be significant in their effects on separation. It was found that gender (female), age at commissioning, marital status (other than married) and race (other than white) were positive influences. The number of dependents (other than one dependent or non) was a negative influence on separation. These findings are consistent with other studies that were summarized in literature review, including Lu (1996) and Pearson (2007). This information indicates that demographics maintain their influence and importance on separation behavior and demographic factors should be analyzed before starting to examine the impact of other factors.

Regarding the effect of education on separation, it was found that advanced education has a significant negative effect on separation of pilots. In particular, pilots possessing an advanced degree, either a Master's Degree or a professional degree, tend to stay in the Air Force compared to their peers who had only Bachelors' Degrees. Partial effects showed that if a pilot has an advanced level of education, e.g., a Master's Degree,

a professional degree, or postmaster's work, he/she is 0.9 percentage points more likely to stay in the Air Force than a pilot with just a Bachelor's Degree. While this percentage is relatively small, this equates to an additional 38 pilots who would leave in this sample.

2. Secondary Research Question

The secondary question was whether commissioning sources affect the separation behavior of USAF pilots. Results indicate that commissioning program is a significant factor in predicting separation. The results indicated that pilots commissioned through USAFA had lower separation rates than ROTC graduates, while pilots commissioned through OTS and other programs had higher separation rates than ROTC graduates. Partial effects showed that graduating from USAFA decreases the separation rate by 0.35 percentage points, while graduating from OTS or other programs increases the separation rate by 0.27 percentage points.

B. POLICY RECOMMENDATIONS

As a result of the findings in this thesis, several policy recommendations appear to be warranted:

1. The U.S. Air Force should continue to support all its pilots to obtain higher education, such as Master's Degree or an advanced professional degree, both through in-residence and off-duty programs. While the Armed Forces still have advanced graduate education schools, such as the Air Force Institute of Technology (AFIT) and Naval Postgraduate School (NPS), USAF could expand the usage of education programs by increasing the number of pilots in those schools. To do so, USAF can expand its capabilities by investing in the educational capabilities of its pilots.

2. While it is obvious that graduate education is beneficial to both the pilots and the Air Force, USAF should search for new ways to expand advanced education for pilots. This is important since it may be considered that providing education could be difficult during active duty. Advanced education choices for both in-residence and off-duty programs may be diversified for pilots who are deployed in different states and countries. Thus, a pilot may have an opportunity to select an advanced education program

that fits his/her work schedule. It seems that properly arranging and encouraging graduate education for pilots might decrease separation rates through the additional service commitments.

3. As is seen from the results of this thesis, USAFA graduates still have higher retention compared to the other commissioning sources. The given motivation, encouraging and teaching the aviation lifestyle to cadets while they are studying at academy, could explain why USAFA graduates are more likely to stay in Air Force after their initial service commitments. The USAF should explore ways to improve the retention behavior of ROTC and OTS commissioned pilots.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

This thesis examined the effects of demographics, education level, and commissioning sources on separation of USAF pilots who were commissioned between 1992 through 2006. Follow-up research could expand the time period to compare and contrast the effects of demographics, education level, and commissioning sources. To improve the predictive accuracy of the models, some additional variables, such as civilian economic employment indexes, civilian airline hiring rates, deployments, flying status and hours of pilots, AFQT scores, Professional Military Education, and information about the type and timing of graduate education, could be added to data sets and provide useful insights.

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